Chapter 15

Quality Systems Audit Criteria & Procedures for Evaluating Ambient Air Monitoring Networks

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APPENDIX

1.0 Introduction

This chapter serves as a guideline for ambient air monitoring network evaluations performed by the Indiana Department of Environmental Management (IDEM), Office of Air Quality (OAQ), Quality Assurance Section (QAS). These evaluations are performed on all organizations (state, local, and industrial/consultant) that report data to the Air Quality System (AQS) database within the State of Indiana. The data are used for statistical analysis and to determine compliance with federal and state air pollution regulations. These network evaluations assist the State in determining the quality of the air monitoring programs in general and the accuracy and reliability of the data being collected. The evaluations are performed in accordance with 40 CFR Parts 50 and 58. Topics covered in this chapter include:

- Ambient Monitoring and Quality Assurance Project Plan (AMQAPP) contents
- AMQAPP Review
- Quality Systems Audit Procedures

The criteria and guidelines used for the evaluations will depend partly on the reason for the monitoring (e.g. Prevention of Significant Deterioration (PSD), State SO_2 Rule (326 IAC 7-3-2), Agreed Order, Special Purpose Monitoring, or the State Implementation Plan (SIP)).

This chapter covers general information on the evaluation process; additional reference information is provided for select sections. For detailed information on monitoring of specific parameters, refer to the appropriate chapters of this manual.

2.0 Ambient Monitoring and Quality Assurance Project Plan

An organization or industry that secures an air quality permit often is required to operate an air-monitoring network to collect evidence of non-degradation of the ambient air. The requirements for ambient air monitoring are identified in the air quality permit, which can be reviewed using the IDEM On-line Permits Search (www.in.gov/ai/appfiles/idem-caats/) and searching the permit for "ambient monitoring requirements."

The guidelines for operating the air-monitoring network are collected in a document called the Air Monitoring & Quality Assurance Project Plan (AMQAPP). This document provides information on the operation of the network including, but not limited to, monitoring equipment standard operating procedures, quality assurance procedures, and data management. The Plan may be written as stand-alone document or may be separated into two plans: a site monitoring plan and a quality assurance project plan (QAPP).

A QAPP is a formal document describing in comprehensive detail the necessary quality assurance (QA), quality control (QC), and other technical activities that must be implemented to ensure that the results of the work performed will satisfy the stated performance criteria. Guidance for developing a quality assurance project plan is found at the following USEPA website:

http://www2.epa.gov/fedfac/assuring-quality-federal-cleanups

The Uniform Federal Policy for Quality Assurance Project Plans (UFP-QAPP) is a consensus document prepared by the Intergovernmental Data Quality Task Force (IDQTF), of which the USEPA was a member. It provides instructions for preparing Quality Assurance Project Plans (QAPPs) for any environmental data collection operation. The main thrust of the UFP-QAPP is the utilization of thirty-seven worksheets to produce the QAPP document. In 2012 the UFP-QAPP was optimized to streamline the preparation and review of the QAPP. The optimization of the UFP-QAPP worksheets was performed in close coordination with USEPA's update of QA/G5, Guidance for Quality Assurance Project Plans.

The ultimate success of an environmental program or project depends on the quality of the environmental data collected and used in decision-making, and this may depend significantly on the adequacy of the QAPP and its effective implementation. It is recommended that the individual worksheets be taken to the project scoping and planning sessions. The use of the worksheets will aid in identifying the critical project information that will ensure that the right type, quality, and quantity of data are collected to meet all of the project's quality objectives. Though the format of each worksheet is not mandatory, the information required on the worksheets must be presented in the QAPP, as appropriate to the project. Each worksheet addresses specific requirements of the UFP-QAPP. Since the content and level of detail in a specific QAPP will vary by program, by the work being performed, and by the intended use of the data, specific worksheets may not be applicable to all projects. In addition, QAPP preparers are encouraged to develop additional tables, as appropriate to the project. Sufficient written discussion in text format should accompany all tables. Certain sections, by their nature, will require more written discussion than others.

[Note: For those who prefer the older style EPA guidance see Appendix A of this chapter. Quality Assurance Project Plan specifications are detailed in *EPA Requirements for Quality Assurance Project Plans*, *EPA QA/R-5* (EPA/240/B-01/003, March 2001) and additional guidance is provided in *Guidance for Quality Assurance Project Plans*, *EPA QA/G-5*, (EPA/240/R-02/009, December 2002).]

A synopsis of the optimized UFP-QAPP worksheets is provided in the following paragraphs:

QAPP Worksheet #1 & 2: Title and Approval Page

This worksheet identifies the principal points of contact of all organizations having decision authority in the project and documents their commitment to implement the QAPP. Signatories usually include the lead organization's Project Manager and QA Manager, and individuals with approval or oversight authority from each regulatory agency. Signatures indicate that officials have reviewed the QAPP and concur with its content and format.

QAPP Worksheet #3 & 5: Project Organization and QAPP Distribution

This worksheet identifies key project personnel, as well as lines of authority and lines of communication among the lead agency, prime contractor, subcontractors, and regulatory agencies. For the purpose of document control, this worksheet also can be used to document recipients of controlled copies of the QAPP.

QAPP Worksheet #4, 7 & 8: Personnel Qualifications and Sign-off Sheet

This worksheet is used to identify key project personnel for each organization performing tasks defined in this QAPP. This worksheet lists individuals' project titles or roles; qualifications; and any specialized/non-routine training, or certifications required by the project.

QAPP Worksheet #6: Communication Pathways

This worksheet should be used to document specific issues (communication drivers) that will trigger the need to communicate with other project personnel or stakeholders. Its purpose is to ensure there are procedures in place for providing the appropriate notifications and generating the appropriate documentation when handling important communications, including those involving regulatory interfaces, unexpected events, emergencies, non-conformances, and stop-work orders.

QAPP Worksheet #9: Project Planning Session Summary

A copy of this worksheet should be completed for each project planning session, whether sessions are internal (project teams only) or external (includes regulators and/or stakeholders). It is used to provide a concise record of participants, key decisions or agreements reached, and action items. Depending on the stage of planning, project-planning sessions should involve key technical personnel as needed. Scoping sessions can be by phone, web-conferencing, and/or face-to-face meeting depending upon logistical considerations. Previous meeting minutes can be included as attachments.

QAPP Worksheet #10: Conceptual Site Model

This worksheet is used to present the project's conceptual site model (CSM). The CSM is a tool to assist in the development of DQOs. The CSM uses primarily text and/or figures but may also include tables to convey succinctly what is currently known about the site, and it should be updated as new data are collected. As with the QAPP in general, the level of detail in the CSM should be based on the graded approach. If an investigation includes multiple sites with unique characteristics or problems to be addressed, then a separate CSM should be prepared for each site.

The CSM should include the following information:

- Background information, i.e., site history (unless this information is presented in an

Executive Summary)
- Sources of known or suspected hazardous pollutants
- Known or suspected contaminants or classes of contaminants
- Primary release mechanism
- Secondary contaminant migration
- Fate and transport considerations
- Potential receptors and exposure pathways
- Land use considerations
- Key physical aspects of the site (e.g., site geology, hydrology, topography, climate); and
- Current interpretation of nature and transport of pollutant to the extent that it will influence project-specific decision-making

QAPP Worksheet #11: Data Quality Objectives

This worksheet is used to develop and document project data quality objectives (DQOs) using a systematic planning process (SPP), such as USEPA's 7-step DQO process. The QAPP must document the environmental decisions that need to be made and the level of data quality needed to ensure that those decisions are based on sound scientific data.

QAPP Worksheet #12: Measurement Performance Criteria

This worksheet documents the quantitative measurement performance criteria (MPC) in terms of precision, bias, and sensitivity for both field and laboratory measurements and is used to guide the selection of appropriate measurement techniques and analytical methods. MPC are developed to ensure collected data will satisfy the DQOs documented on Worksheet #11. A separate worksheet should be completed for each type of field or laboratory measurement. For analytical methods, MPC should be determined for each matrix, analyte, and concentration level. [Qualitative MPC (representativeness and comparability) should be addressed in the sample design, which is documented on Worksheet #17.]

QAPP Worksheet #13: Secondary Data Uses and Limitations

This worksheet should be used to identify sources of secondary data (i.e., data generated for purposes other than this specific project or data pertinent to this project generated under a separate QAPP) and summarize information relevant to their uses for the current project. Secondary data can include the following: sampling and testing data collected during previous investigations, historical data, background information, interviews, modeling data, photographs, aerial photographs, topographic maps, and published literature. This worksheet should be supplemented by text describing specifically how all secondary data will be used.

QAPP Worksheet #14/16: Project Tasks & Schedule

The QAPP should include a project schedule showing specific tasks, the person or group responsible for their execution, and planned start and end dates. Options for presenting this

information include using a Gantt chart that can be attached and referenced. Examples of activities that should be listed include key on-site and off-site activities. Any critical steps and dates should be highlighted.

QAPP Worksheet #15: Project Action Limits and Laboratory-Specific Detection/Quantitation Limits

This worksheet should be completed for each matrix, analyte, analytical method, and concentration level (if applicable). Its purpose is to make sure the selected analytical laboratory and method can provide accurate data (i.e., quantitative results with known precision and bias) at the Project Action Limit (PAL). During the systematic planning process, identify target analytes, PALs, and the reference limits (e.g. regulatory limits or risk-based limits) on which action limits are based. Target analytes that are critical to project-specific decision-making should be highlighted. Next, determine the matrix-specific quantitation limit goal. The quantitation limit goal should be lower than the PAL by an amount determined by the DQOs. This information, along with the MPC documented on Worksheet #12, should be used to select analytical methods and laboratories. Once the methods and laboratories have been selected, the remaining columns should be completed with laboratory-specific information. The laboratory must provide documentation that demonstrates precision and bias at the laboratory-specific quantitation limit.

QAPP Worksheet #17: Sampling Design and Rationale

This worksheet should be used to describe the sampling design and the basis for its selection. This worksheet will mainly consist of text. It documents the last step of the systematic planning process. If a site consists of multiple areas to be sampled, a separate worksheet should be used for each. There are two general types of sampling designs: 1) probability-based designs, which should be used when statistical conclusions are required, and 2) judgmental designs, which are more applicable to help refine conceptual site models when further study is planned, or to confirm previous findings, but which usually do not provide sufficient basis on their own to support statistical conclusions. Advice on selecting appropriate sample designs may be found in Chapter 2 of Guidance for Choosing a Sampling Design for Environmental Data Collection, EPA QA/G-5s.

QAPP Worksheet #18: Sampling Locations and Methods

The primary value of this worksheet is as a completeness check for field personnel and auditors/assessors. It facilitates checks to make sure all planned samples have been collected and appropriate methods have been used. A map with locations marked should be included. Detailed sampling SOPs must be available to field personnel and should be included as an appendix to the QAPP and referenced in this worksheet. The comments field can be used as a reminder to note any special sample handling required in the field and/or GPS coordinates.

QAPP Worksheet #19 & 30: Sample Containers, Preservation, and Hold Times

The purpose of this worksheet is to serve as a reference guide for field personnel and as an aid to completing the Chain of Custody form and shipping documents. If laboratory accreditation or certification is required for this project, the project team must verify that the laboratory maintains current accreditation/certification status for each analyte/matrix/method combination, as applicable, throughout its involvement with the project.

QAPP Worksheet #20: Field QC Summary

This worksheet provides a summary of the types of samples to be collected and analyzed. Its purpose is to show the relationship between the number of field samples and associated QC samples for each combination of analyte/analytical group and matrix. This worksheet is also useful for informing the laboratory of the expected number of samples. The number and types of QC samples should be based on project-specific DQOs, and this worksheet should be adapted as necessary to accommodate project-specific requirements (e.g. proficiency testing samples).

QAPP Worksheet #21: Field SOPs

This worksheet is intended for use to document the specific field procedures being implemented, which is important for measurement traceability. The QAPP must contain detailed descriptions of procedures for all field activities, including sample collection and sample preservation; sample handling and custody; and equipment testing, maintenance and inspection. If these procedures are included in existing SOPs, those SOPs should be reviewed to make sure they are either 1) sufficiently prescriptive to be implemented as written, or 2) modified as necessary for this project. Basic information about the SOPs should be provided in this table, and the SOPS themselves should be included in an appendix to the QAPP. Field SOPs must be readily available to all field personnel responsible for their implementation.

QAPP Worksheet #22: Field Equipment Calibration, Maintenance, Testing, and Inspection

This worksheet should document procedures for calibrating, maintaining, testing, and/or inspecting all field equipment (e.g., pumps, gauges, etc.). If these activities are documented in an SOP or manufacturer's instructions, and the relevant SOP or instruction is attached, then the frequency, acceptance criteria and corrective action columns may be left blank. All information summarized in this worksheet should be recorded in the field notes/logs.

QAPP Worksheet #23: Analytical SOP's

This worksheet documents information about the specific sample preparation and analytical procedures to be used, which is important for measurement traceability. SOPs for all sample preparation and analytical procedures must be current and referenced whether these activities are performed in the field or in a laboratory. All SOPs must be reviewed to make sure they are either 1) sufficiently prescriptive to be implemented as written or 2) modified as necessary for this

project. If required by the project, copies of the SOPs should be included as a hardcopy or electronic appendix so that access is available to all personnel responsible for implementing sample preparation and analytical SOPs.

QAPP Worksheet #24: Analytical Instrument Calibration

This worksheet should be completed for all analytical instruments, field and laboratory. As appropriate to the instrument, calibration procedures should include initial calibration, zero/blank calibration, span calibration/verification, and verification of detection and quantification limits. If information for a specific procedure is provided in an SOP, and the SOP is attached, then this worksheet can reference the SOP and identify the responsible person.

QAPP Worksheet #25: Analytical Instrument and Equipment Maintenance, Testing, and Inspection

This worksheet should be completed for all analytical instruments, field and laboratory. If information for a specific procedure is provided in an SOP, and the SOP is attached, then this worksheet can reference the SOP and identify the responsible person.

QAPP Worksheet #26 & 27: Sample Handling, Custody, and Disposal

This worksheet is used to document responsibilities for maintaining custody of samples from sample collection through disposal. Examples of forms, sample labels, and chain of custody documentation should be included as an attachment to the QAPP. The information in this worksheet table can be referenced to the appropriate SOPs if they are attached to the QAPP.

QAPP Worksheet #28: Analytical Quality Control and Corrective Action

The purpose of this worksheet is to ensure that the selected analytical methods are capable of meeting project-specific MPC, which are based on DQOs. Complete a separate worksheet for each sampling technique, analytical method/SOP, and analytical group. If method/SOP QC acceptance criteria do not meet the project-specific MPC, the data obtained may be unusable for making reliable project decisions.

QAPP Worksheet #29: Project Documents and Records

This worksheet should be used to record information for all documents and records that will be generated for the project. It describes how information will be collected, verified, and stored. Its purpose is to support data completeness, data integrity, and ease of retrieval.

QAPP Worksheet #31, 32 & 33: Assessments and Corrective Action

This worksheet is used to document responsibilities for conducting project assessments, responding to assessment findings and implementing corrective action. Appropriately scheduled

assessments (e.g., field sampling technical systems audits (TSA) at the beginning of sampling) allow management to implement corrective action in a timely manner, thereby correcting non-conformances and minimizing their impact on DQOs. Assessment checklists should be included in the QAPP or referenced.

QAPP Worksheet #34: Data Verification and Validation Inputs

This worksheet is used to list the inputs that will be used during data verification and validation. Inputs include planning documents, field records, and laboratory records. Data verification is a check that all specified activities involved in collecting and analyzing samples have been completed and documented and that the necessary records (objective evidence) are available to proceed to data validation. Data validation is the evaluation of conformance to stated requirements, including those in the methods, SOPs and the QAPP.

QAPP Worksheet #35: Data Verification Procedures

This worksheet documents procedures that will be used to verify project data. It applies to both field and laboratory records. Data verification is a completeness check to confirm that all required activities were conducted, all specified records are present, and the contents of the records are complete.

QAPP Worksheet #36: Data Validation Procedures

This worksheet documents procedures that will be used to validate project data. Data validation is an analyte and sample-specific process for evaluating compliance with methods/SOPs, and MPC. The scope of data validation needs to be defined during project planning because it affects the type and level of documentation required for both field and laboratory activities. If data validation procedures are contained in an SOP or other document, the procedures should be referenced in this table and included as an attachment to the QAPP. The validation code and label identifier table, as well as any checklists to be used should be attached to the QAPP. Any data qualifiers to be applied by the data validator must be defined. Data validation should note when performance criteria are not met but the final rejection of any data and their use is a decision reserved specifically for the project team.

QAPP Worksheet #37: Data Usability Assessment

This worksheet documents procedures that will be used to perform the data usability assessment. The data usability assessment is performed at the conclusion of data collection activities, using the outputs from data verification and data validation. It is the data interpretation phase, which involves a qualitative and quantitative evaluation of environmental data to determine if the project data are of the right type, quality, and quantity to support the decisions that need to be made. It involves a retrospective evaluation of the systematic planning process, and, like the systematic planning process, involves participation by key members of the project team. The data usability assessment evaluates whether underlying assumptions used during systematic

planning are supported, sources of uncertainty have been accounted for and are acceptable, data are representative of the population of interest, and the results can be used as intended, with the acceptable level of confidence.

3.0 Ambient Monitoring and Quality Assurance Project Plan Review and Approval

Prior to initiating any monitoring, an Ambient Monitoring and Quality Assurance Project Plan (AMQAPP) must be submitted to the IDEM Air Monitoring Branch for review and approval. The submitted plan does not necessary have to contain all the AMQAPP elements listed in Section 2.0, but must contain all the necessary information to perform the project. The Air Monitoring Branch reviews the AMQAPP to ensure the proposed network meets all applicable regulations and guidelines concerning operation of an ambient air network.

Upon receipt of the AMQAPP from the submitting organization, it is given to a reviewer, normally the QA staff member responsible for industrial evaluations. The reviewer may contact other Branch staff members to assist with the review. A time frame must be developed so all applicable participants in the review process have adequate time to review and comment on the plan, so that the plan can be returned to the submitting organization within thirty days of receipt.

To assist the reviewer, AMQAPP check sheets are available in Appendix C of the *Guidance for Quality Assurance Project Plans (QA/G-5)* (EPA/240/R-02/009, December 2002). After reviewing the plan, the reviewer(s) shall prepare a list of requirements or recommendations that need to be added, deleted, edited, or corrected to make the Plan a better and more complete document. Requirements are procedures that must be met, while recommendations are made to ensure procedures are consistent for similar plans throughout the state.

After the list of requirements and recommendations, if any, has been compiled, an approval/recommendation letter is written by the QAS with comments stating those requirements and recommendations needed to make the Plan complete. The comments are then sent back to the reporting organization and any involved parties pending any required changes in operation or documentation. Reviewing the AMQAPP prior to the project start date is an effective way to catch procedural errors early.

Revisions and updates to the Plan also must be reviewed as changes occur to the network.

4.0 Ambient Air Monitoring Quality Systems Audit

The IDEM Quality Assurance Section attempts to perform an annual ambient air monitoring systems assessment of all industries that submit ambient air monitoring data to USEPA's Air Quality System (AQS). An ambient air monitoring quality systems audit is an evaluation process used to evaluate the performance or effectiveness of a system and its elements; and consists of

- A data quality assessment
- A technical assessment, and

- A performance evaluation

A *data quality assessment* is a scientific and statistical evaluation of validated data to determine if the data are of the right type, quality, and quantity to support their intended use. A *technical assessment* provides a qualitative examination of a monitoring network to determine whether environmental data collection activities and its related results comply with the network's quality assurance project plan. A *performance evaluation* is a type of audit in which the quantitative data generated in a measurement system are independently obtained and compared with routinely obtained data to verify the performance of the equipment. Additional information on the various types of audits and assessments can be found in *Guidance on Technical Audits and Related Assessments for Environmental Data Operations (EPA QA/G7)* (EPA/600/R-99/080, January 2000).

5.0 Quality Systems Audit Procedures

The evaluation process begins by contacting the site operators approximately 30 days prior to the evaluation to schedule a site visit date. Once a date for a site visit is finalized, the industrial site book is reviewed to ensure the information is up-to-date. The site book contains pictures, maps, a site evaluation form (Form 1), and specific information on the air monitoring networks. If all sites in a network cannot be visited, the sites with the most problems during the last evaluation and the sites which have not been evaluated the previous year will have priority. The evaluation process generally involves reviewing all documentation, reviewing certification information, checking siting criteria, conducting performance evaluations, and evaluating operator technique. This process is followed with detailed correspondence describing program deficiencies with recommendations that may improve the monitoring network performance.

5.1 Data Quality Assessment

Prior to the site visit, a review should be performed of the monitoring network's previous year measurement quality objectives and operating data. The measurement quality objectives (MQOs) include the following:

- Precision
- Accuracy
- Bias
- Detectability
- Completeness
- Comparability

5.1.1 AQS QA Data Reports

Four MQOs (Precision, Accuracy, Bias, and Completeness) can be assessed quantitatively and the procedures for calculating the appropriate statistics of precision and bias are found in Appendix A of 40CFR Part 58 and in Chapter 13 of the Quality Assurance Manual. The data and statistics also have been compiled by EPA's Air Quality System (AQS) and can be accessed via the following reports:

- AMP 256, QA Data Quality Indicator Report (Precision, Bias, Accuracy)
- AMP 430, Data Completeness (Completeness)

The QA Data Indicator Summary Data Report (AMP256) provides statistical estimates of the precision, bias, and accuracy of monitors of criteria air pollutants, and it summarizes the completeness of monitor checks (number of 1-point QC audits and performance evaluations conducted during the evaluation period) from which the statistical estimates are derived. The Data Completeness Report (AMP 430) is a raw data report that generates a monthly count of the number of observations conducted by a monitor across a given time frame. It also calculates the percentage of valid observations that are collected within the month.

The one-point QC audit data used in calculating the precision and bias statistics and the performance evaluation audit data are found in the QA Raw Assessment Report (AMP 251). This report lists the one-point QC audit data pairs and calculates the percent difference between the reported values for a monitoring site(s). USEPA provides a stand-alone EXCEL application, the Data Assessment Statistical Calculator (DASC), for those inclined to calculate and verify precision and bias statistics (http://www.epa.gov/ttn/amtic/files/ambient/qaqc/dascv3.xls).

5.1.2 Monitoring Site Ambient Air Data

An annual statistical summary of the parameter data reported by the network air quality monitors can be accessed via the Maximum Values Report (AMP 440), and the Frequency Distribution Report (AMP 230). The Maximum Values Report (AMP440) presents selected summary statistics including the number of observations, number of observations above the standard, maximum value, and the ten highest concentrations for the monitor during the given year. The Frequency Distribution Report (AMP230) presents selected summary statistics including the number of observations, number of observations above the standard, maximum value, and the defined percentiles for the system.

Additional information on the data collected by the network can be found in the Quick Look Report (AMP 450) and the Daily Summary Report (AMP 435). The Quick Look Report displays a unique format for each of the criteria pollutants designed to highlight special calculations that are derived for the given pollutant in order to determine compliance with the National Ambient Air Quality Standards. The Daily Summary Report (AMP 435) provides basic statistics for all reported sample data with durations of less than 24 hours. In addition to sample data, the daily summaries will include any criteria pollutant data (regardless of the sample duration) as well as

summarized NAAQS averages, when applicable. The report will provide a tabular listing of the following daily statistics: average, number of samples, data capture rate for the day, maximum sample value, hour of the maximum sample value, and daily ranking.

5.2 Technical Assessment

A "technical assessment" of the network is performed by reviewing calibrations, audits, and other documentations to ensure timelines are met and information is accurate. In addition, site operator procedures and documentation are compared to the procedures outlined in the monitoring site's Quality Assurance Project Plan. Other aspects of the assessment are to review the site logbook for information about analyzer drift, calibrations, specific problems with the instruments, and what actions were taken by the site operators. Furthermore, the site logbook should reveal if any data was invalidated and why. For sites with particulate samplers, the filter logbook is checked to ensure quality assurance limits and procedures are consistent with the AMQAPP.

5.2.1 Documentation

The reporting organization's documentation is checked to ensure that all work performed is consistent with the 40 CFR Part 58, the USEPA Quality Assurance Handbook for Air Pollution Measurement Systems, and the IDEM, OAQ, QA manual. The site logbook, quarterly reports, and other pertinent paperwork are reviewed to verify documentation is organized and useful. The following areas are examined by the QAS to verify that adequate documentation is maintained:

- biweekly 1-point QC audits and quarterly performance evaluations
- quarterly Quality Assurance Reports for USEPA's Air Quality System (AQS)
- equipment certifications, verifications, and calibrations

The documentation of the areas above is checked to ensure that calculations are performed correctly; audits are run in the correct concentration ranges; and audits, calibrations, and equipment verifications and certifications are performed in a timely manner. Documentation is also checked to answer the following questions:

- Was the analyzer calibrated within the last six months
- For permeation audit systems, was the rotameter calibrated or are flows recorded to calculate the output concentration
- Was the indoor temperature sensor certified by the site operator and was the certification documented
- Are the accuracy audits performed with different equipment than that used to calibrate the analyzer
- Are there periods of invalid data and if so, was the reason of the invalid data documented

Prior to the evaluation, AQS Quality Assurance submittals are checked prior to ensure timely submittal, audit results are within limits, and audits are performed within the appropriate concentration ranges.

Furthermore, if particulate monitoring is being performed, a well-organized logbook must be kept to ensure proper quality assurance procedures are followed. If the industry or consulting firm performs particulate filter weighing, the QAS will check the following items:

- quality assurance checks of initial and final weights to ensure they are being performed and meet the limits for weight and minimum number of filters reweighed
- the equipment used in the filter preparation area is certified (e.g. thermometers, relative humidity sensors, ANSI Class weights) and copies of certifications performed by the company or agency are being sent to the QAS
- the balance checks are performed in the correct ranges
- the filter cards are checked for chain-of-custody, pre and post sampling flow meter drift checks, elapsed time 1440 minutes ±60 minutes
- filter handling and weighing procedures meet requirements (see Chapter 7)

If the industry or consulting firm contracts the filter weighing, a filter handling questionnaire is sent to the contract laboratory that performs the filter weighing procedures (Form 3).

5.2.2 Certifications

The reporting organization's certification information is reviewed to ensure that the transfer standards used for calibrations and audits are within the specified certification period and whether the standards are certified through the IDEM QA certification facility or other certified entity. Copies of all certifications must be available for review. This ensures that all transfer standards throughout the state are referenced back to primary standards used by the State of Indiana for uniformity and accuracy. The certifications must meet the time frames and criteria established in Chapter 6, Certification Methods of Transfer Standards, of the Quality Assurance Manual. If the agency or company performs its own certifications, then copies of these certifications must be sent to the QAS. All consulting firms hired to perform calibrations or accuracy audits must also certify their transfer standards with the QA Section if the air monitoring data is to be submitted to the AQS for the State of Indiana. Equipment certifications may be reviewed prior to the site visit by the QAS. Accuracy audit and calibration records are reviewed to ensure a designated, certified piece of equipment is used for each procedure.

5.2.3 Site Description

The Site Description is a physical description of the monitoring site relative to its surroundings and most of this information should be collected during the initial site visit. It involves

- obtaining cardinal and ordinal directional photographs surrounding the site
- collecting longitude, latitude, and elevation GPS coordinates

- obtaining a satellite map of the monitoring site and the surrounding area
- measuring distances to roadways and nearby obstructions, and
- measuring or estimating the heights of sample probes and nearby obstructions

A site evaluation form provides specific site information on continuous and intermittent parameters (see Form 1) and is completed upon the initial visit, and checked during each audit. The meteorological parameters have additional site evaluation forms to ensure that the siting is adequate (see Chapter 9, Meteorological Systems). In addition, when a site is visited for an audit, a site inspection form (Form 2) is completed. These forms, along with the photographs and maps of the site, are collected and saved electronically.

In addition to the cardinal and ordinal directional photographs around the site, photographs are taken of instruments at the sites. Additional photographs will be taken if questionable siting criteria exist. A GPS unit may be used to evaluate the site geographic position (longitude, latitude, elevation).

A detailed satellite map of the monitoring site can be downloaded from the Internet (Google, Bing) and relevant information (distances and directions to obstructions, ground cover, distances to the parameter source, etc.) can be superimposed on the satellite map.

Several items need to be considered when measuring distances to potential obstructions:

- the direction of the source
- topography (e.g., influence of hills and valleys)
- parameter siting requirements
- the type of monitoring, and
- the type of obstruction (trees or building)

The general rule to follow when measuring for obstructions is the 2 times rule. This rule states the distance to an obstruction must be at least twice the distance that the height of the obstruction extends above the inlet or probe. The siting is checked on every evaluation to ensure that changes have not occurred, such as new tree growth interfering with siting criteria.

5.3 Performance Evaluation

The "performance evaluation" is a quantitative assessment of the performance of continuous monitors, intermittent samplers, and/or meteorological parameters. The assessment follows the guidelines of the *Quality Assurance Handbook for Air Pollution Measurement Systems, Vol. II: Ambient Air Quality Monitoring Program*, (EPA-454/B-13-003, December 2013), *Quality Assurance Handbook for Air Pollution Measurement Systems, Vol. IV: Meteorological Measurements, Version 2.0*, (EPA-454/B-08-002, March 2008), and pertinent parameter chapters of this Manual.

5.3.1 Continuous Gas Analyzer Audit

When auditing a continuous air monitoring analyzer, three or more audit levels from Table 1 are introduced into the analyzer and compared to the values observed from the analyzer. The results are compared against the measurement quality objectives of the monitoring network AMQAPP or the USEPA QA Handbook and are a measure of analyzer performance. The performance evaluation results of the network continuous analyzer must be within ± 15% of the IDEM gas concentration for each tested audit level.

Table 1
Performance Evaluation Audit Levels

Audit Level	O_3, ppb	SO_2, ppb	NO_2, ppb	CO, ppm
1	0.004 – 0.0059	0.0003 – 0.0029	0.0003 – 0.0029	0.020 – 0.059
2	0.006 – 0.019	0.0030 – 0.0049	0.0030 – 0.0049	0.600 – 0.199
3	0.020 – 0.039	0.0050 – 0.0079	0.0050 – 0.0079	0.200 – 0.899
4	0.040 – 0.069	0.0080 – 0.0199	0.0080 – 0.0199	0.900 – 2.999
5	0.070 – 0.089	0.0200 – 0.0499	0.0200 – 0.0499	3.000 – 7.999
6	0.090 – 0.119	0.0500 – 0.0999	0.0500 – 0.0999	8.000 – 15.999
7	0.120 – 0.139	0.1000 – 0.1499	0.1000 – 0.1499	16.000 – 30.999
8	0.140 – 0.169	0.1500 – 0.2599	0.1500 – 0.2599	31.000 – 39.999
9	0.170 – 0.189	0.2600 – 0.7999	0.2600 – 0.7999	40.000 – 49.999
10	0.190 – 0.259	0.8000 – 1.000	0.8000 – 1.000	50.000 – 60.000

Ref: *Office of Air Quality Planning and Standards technical memorandum, Subject: Use of Expanded List of Audit Levels for Annual Performance Evaluation for SO_2, NO_2, O_3, and CO as described in 40 CFR Part 58 Appendix A Section 3.2.2, dated November 10, 2010.*

The information collected when conducting a continuous analyzer network performance audit includes, but is not limited to:

- Does the analyzer display any alarms
- Is the analyzer within its calibration period
- Is there a 5% offset on the strip chart
- Do the values of the strip chart recorder match the data logger
- Have the strip chart recorder and the data logger been calibrated
- Are the calibrator and span tanks certified
- Does the daily span/zero meet the drift limits for 24-hour periods
- Is the sample train composed of nonreactive material? (e.g. Teflon, borosilicate glass)
- Is the sample train residence time less than twenty seconds
- Have the site operator explain how an audit is performed. Does the procedure follow the QAPP standard operating procedure

5.3.2 Particulate Matter Audit

Particulate (intermittent and continuous) audits consist of checks of the sampler's temperature and pressure devices, a one-point flow comparison with a QA calibrated flow device, and leak check of the system. The results should fall within the requirements outlined in the monitoring network's AMQAPP or in Table 2 from the measurement quality objectives outlined in the USEPA QA Handbook.

Table 2
PM Performance Evaluation Audit Criteria

Criteria	Acceptable Range
Flow Rate audit	
$PM_{2.5}$ – manual & continuous	≤ ± 4% of audit transfer standard ≤ ± 5% of design flow rate
PM_{10} (low volume) – manual & continuous	≤ ± 4% of audit transfer standard ≤ ± 5% of design flow rate
(PM_{10} (high volume)	≤ ± 7% of audit transfer standard ≤ ± 10% of design flow rate
(Pb (high volume) – manual)	≤ ± 7% of audit standard
Ambient Temperature audit	within ± 2 °C
Barometric Pressure audit	within ± 10 mm Hg
Leak Check	≤ 25 mm Hg/min (R& P 2025) < 1.0 lpm (Met One BAM) < ± 0.15 lpm (TEOM main flow), < ± 0.60 lpm (TEOM bypass flow)

A lot of information can be collected by discussing the site procedures with the site operators. The following items are examples of information gathered when conducting a particulate sampling network evaluation and include, but are not limited to:

- Are water/oil manometers leak checked prior to use
- Is the thermometer placed out of direct sunlight
- How is the barometric pressure taken? If the barometric pressure is taken from weather station information, is it corrected to station pressure
- Who performs the quarterly flow audits, monthly flow verifications, and calibrations
- For hi-vol samplers (Hi-vol PM10 and Hi-vol Pb), are the elapsed time meters (ETMs) certified

5.3.3 Meteorological Audit

The meteorological audit procedures will vary with the parameter and follow the guidelines in Chapter 9 of the IDEM QA Manual and the EPA *Quality Assurance Handbook for Air Pollution Measurement Systems, Vol. IV: Meteorological Measurements, Version 2.0,* (EPA-454/B-08-002, and March 2008). Acceptance criteria for the more commonly observed meteorological parameters are listed in Table 3.

Table 3
Meteorological Performance Evaluation Audit Criteria

Measurement	Type	Acceptance Criteria	
Ambient Temperature	3 point Water Bath with NIST-traceable thermistor or thermometer	SPM	< ±1.0 °C
		PSD	< ±0.5 °C
Relative Humidity	NIST-traceable Psychrometer or Standards solution	SPM	< ±10% RH
		PSD	< ±7% RH
Wind Speed	NIST-traceable synchronous motor	SPM	< ±0.5 mph for shaft speed ≤ 10 mph; < ±5% for shaft speed > 10 mph
		PSD	< 0.4 mph
Wind Direction	Solar Noon, GPS, or Magnetic Compass	SPM/PSD	< ± 5 degrees including orientation error

Acceptance criteria for Prevention of Significant Deterioration (PSD) monitoring is more rigorous than that for Special Purpose Monitoring (SPM) (e.g., Sulfur Rule 326 IAC 7-3-2). Siting criteria audit forms for evaluating the meteorological parameters can be found in Chapter 9 of the IDEM QA Manual.

5.3.4 Site Safety Conditions and Site Cleanliness

During the performance evaluation, information is collected on the safety conditions and the cleanliness of the sites and documented using Form 2. The following items are checked for safety:

- Exhaust from a gas parameter analyzer is vented to the outside or to a scrubber column
- Exterior electrical connections should not be exposed to the weather
- Extension cords should not be cracked or brittle

- Ladders and railings should be secure
- Cylinders should be secured with a chain or tie down strap
- Access to the site should be safe in general

The following items are checked for cleanliness:

- A particulate sampler should be free of dust and dirt in the filter collection area and overall
- The manifold used in continuous sampling should be free of dust and dirt
- The candy cane used in continuous sampling should be free of dust and dirt
- The sample lines going from the manifold to the continuous analyzers should be free of dust, dirt, and condensation
- The continuous analyzers should be free of dust, dirt, and clutter
- The overall condition of the site should be free of extra equipment, bent or rusty fencing, broken skirting, etc.

6.0 Ambient Air Quality Systems Audit Report

A report of the quality systems audit will be forwarded to the monitoring site contact. The report will provide the results of the performance evaluation (instrument response to a known value or standard), summary of the data quality assessment, and any deficiencies noted in the technical assessment. In addition, recommendations for improving the air-monitoring program may be included.

7.0 References

EPA Requirements for Quality Assurance Project Plans, EPA QA/R-5 (EPA/240/B-01/003, March 2001)

Guidance for Quality Assurance Project Plans, EPA QA/G-5, (EPA/240/R-02/009, December 2002)

Guidance on Systematic Planning using the Data Quality Objective Process, EPA QA/G-4, (EPA/240/B-06/001, February 2006)

Guidance on Technical Audits and Related Assessments for Environmental Data Operations (EPA QA/G7) (EPA/600/R-99/080, January 2000).

Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II: Ambient Air Quality Monitoring Program, (EPA-454/B-13-003, December 2013)

Quality Assurance Handbook for Air Pollution Measurement Systems, Vol. IV: Meteorological Measurements, Version 2.0, (EPA-454/B-08-002, March 2008).

Form 1

Continuous and Intermittent Site Evaluation

Site Name:_____ **Date:** _____

GPS Coordinates: N_____ **AQS #:**_____

W_____ **Auditors:** _____

I. Scale of Representativeness

Parameter	Micro	Middle	Neighborhood	Urban	Regional	N/A
SO_2						
CO						
O_3						
NO_2						
Pb						
PM_{10} - Int						
PM_{10} - Cont						
$PM_{2.5}$ - Int						
$PM_{2.5}$ - Cont						
Speciation						
Black Carbon						
Met						
Toxics						

Is this station category (a) highest concentration, (b) population exposure, (c) upwind background, or (d) general background?

Parameter -	$PM_{2.5}$	PM_{10}	SO_2	CO	O_3	NO_2	Pb	Spec.	BC	Met	Toxics
Category -	____	____	____	____	____	____	____	____	____	____	_____

II. Probe Siting

1. Probe Height, measured from ground level to probe inlet (2-meters minimum).

	$PM_{2.5}$	PM_{10}	SO_2	CO	O_3	NO_2	Pb	Spec.	BC	Met	Toxics
Height:	____	____	____	____	____	____	____	____	____	____	_____

2. Obstructions - Distance to the obstruction must be greater than two times the height of the obstruction which extends above the probe. Are there any obstructions? (Yes/No)

   a. Obstructed parameter:

$PM_{2.5}$	PM_{10}	SO_2	CO	O_3	NO_2	Pb	Spec.	BC	Met	Toxics
____	____	____	____	____	____	____	____	____	____	_____

   b. Distance (in meters) to Obstruction:

$PM_{2.5}$	PM_{10}	SO_2	CO	O_3	NO_2	Pb	Spec.	BC	Met	Toxics
____	____	____	____	____	____	____	____	____	____	_____

   c. Compass direction of Obstruction:

$PM_{2.5}$	PM_{10}	SO_2	CO	O_3	NO_2	Pb	Spec.	BC	Met	Toxics
____	____	____	____	____	____	____	____	____	____	_____

   d. Height above the probe:

$PM_{2.5}$	PM_{10}	SO_2	CO	O_3	NO_2	Pb	Spec.	BC	Met	Toxics
____	____	____	____	____	____	____	____	____	____	_____

3. Is the probe greater than 20 meters from the drip line of trees? (Yes/No)
   If less than 20 meters, how far to the drip line?

$PM_{2.5}$	PM_{10}	SO_2	CO	O_3	NO_2	Pb	Spec.	BC	Met	Toxics
____	____	____	____	____	____	____	____	____	____	_____

4. Is the PM sampler greater than two meters from walls, parapets, etc.? (Yes/No/NA)
   If not, how far is the sampler from the wall or parapet?

5. Is the continuous monitoring probe greater than one meter from any walls or supporting structure? (Yes/No/NA)
   If not, what is the distance between the probe and wall?

6. Is the probe located away from dirty, dusty areas? (Yes/No)
   If not, what is the issue?

7. 270° Rule - At least 270° (180° if located on the side of a building) around the sampler inlet must be unobstructed. The 270° arc must include the predominant wind direction for the season of expected highest concentration. Does the sampler meet this rule? (Yes/No)

. Is the PM sampler located in an area that is paved or has vegetative ground cover year round? (Yes/No/NA)
What is the primary ground cover?

9. Are any furnace or incineration flues nearby? (Yes/No)
If yes, what is the distance (in meters) between the sampler or probe and the flue?

$PM_{2.5}$	PM_{10}	SO_2	CO	O_3	NO_2	Pb	Spec.	BC	Met	Toxics
____	____	____	____	____	____	____	____	____	____	_____

10. Name of nearest traffic lane:
Distance to nearest traffic lane: Name of nearest traffic lane:

$PM_{2.5}$	PM_{10}	SO_2	CO	O_3	NO_2	Pb	Spec.	BC	Met	Toxics
____	____	____	____	____	____	____	____	____	____	_____

11. Are all probes, manifolds, candy canes, etc., FEP Teflon or borosilicate glass? (Yes/No/NA)
If not, list parameter and the type of material used.

12. If the samplers are collocated, do they meet distance requirements (horizontal distance within 1 – 4 meters, vertical distance less than 1 meter)? (Yes/No/NA)
If not, list the vertical & horizontal distances that do not meet the requirements.

13. Calculate the residence time (in seconds) for a gas to travel from the candy cane inlet to the back of the analyzer inlet, using hand calculations or a spreadsheet. Attach the calculations to this form.

Residence Time, seconds:	SO_2	O_3	NO_2	CO
	____	____	____	____

14. a. Collected photos of the cardinal/ordinal directions? (Yes/No)
b. Collected photos of any obstructions or potential issues? (Yes/No)
c. Collected photos of the overall site and interior shelter configuration ? (Yes/No)

COMMENTS:_____

_____

_____

_____

Form 2
Site Inspection Form

SITE_____ AUDITOR_____ DATE _____

CONTINUOUS

DAS, ANALYZERS & RECORDERS CLEAN AND OPERATING PROPERLY	YES / NO _____
DAS, ANALYZERS & RECORDERS READING CONSISTENTLY WITH ONE ANOTHER	YES / NO _____
ZERO/SPAN(S) OPERATING	YES / NO _____
MANIFOLD CLEAN & MOTOR FUNCTIONING	YES / NO _____
CANDY CANE & PROBE LINE(S) CLEAN	YES / NO _____
LOGBOOK(S) DOCUMENTED & CURRENT	YES / NO _____
CALIBRATION FORM(S) ON SITE	YES / NO _____
FIRST AID KIT ON SITE	YES / NO _____
INSTRUMENT MANUAL(S) ON SITE	YES / NO _____
CALIBRATION STICKER(S) CURRENT	YES / NO _____
CYLINDER(S) SECURE	YES / NO _____
INTERIOR: COUNTER, FLOOR, CEILING CLEAN	YES / NO _____
EXTERIOR: GATE, FENCE, STEPS, SKIRTING	YES / NO _____
OBSTRUCTIONS MEET THE 2 TIMES RULE	YES / NO _____

INTERMITTENT

INSIDE OF SAMPLER(S) CLEAN	YES / NO _____
FILTER HOLDER GASKET IN GOOD CONDITION	YES / NO _____
CALIBRATION STICKER(S) CURRENT	YES / NO _____
ETM(S) FUNCTIONING	YES / NO _____
CLOCK(S) READING CORRECT TIME	YES / NO _____
SAMPLER(S) SECURE: CLIPS, NUTS, CABLES	YES / NO _____
SAFE ACCESS TO SITE: STEPS, RAILING	YES / NO _____
ELECTRICAL CONNECTION(S) TAPED	YES / NO _____
ELEC. CORDS INSULATION & LOCATION GOOD	YES / NO _____
OBSTRUCTIONS MEET THE 2 TIMES RULE	YES / NO _____

Form 3
Filter Handling Questionnaire

Please answer the following questions. If any questions are answered no, please explain.

Reporting Agency: _____ **Date:** _____

		Yes	No
1.	Is the temperature in the weighing facility kept between 15 °C to 30 °C?	____	____
2.	Is the temperature in this room controlled within ±3 °C?	____	____
3.	Is the humidity in the weighing facility kept below 50%?	____	____
4.	Is the humidity controlled within ±5%?	____	____
5.	Is your filter conditioning area free from all acidic or basic gases that might react with the filter media or the collected particulate matter during filter conditioning?	____	____
6.	Is your analytical balance checked with Class 1 weights prior to weighing filters?	____	____
7.	Does your company desiccate filters for approximately 24 hours prior to weighing filters before and after runs?	____	____
8.	Does your company reweigh initial filter weights?	____	____
9.	Does your company initially inspect filters for irregularities or inconsistencies in the filters?	____	____
10.	Does your company reweigh exposed filters?	____	____
11.	Does your company maintain bound filter logbooks?	____	____
12.	Does your company send all pertinent filter information along with the monitoring report?	____	____
13.	Does your company transport and store filters separately?	____	____
14.	Does your company maintain filter information for at least three years?	____	____
15.	How long after an intermittent sample is collected before the filter is received by the lab?	_____	
16.	How long after the filter is received by the lab before the analysis is done?	_____	

Appendix A

An older version of Quality Assurance Project Plan specifications detailed in *EPA Requirements for Quality Assurance Project Plans, EPA QA/R-5* (EPA/240/B-01/003, March 2001) is presented here. Additional guidance was provided in *Guidance for Quality Assurance Project Plans, EPA QA/G-5*, (EPA/240/R-02/009, December 2002). These documents divide the plan into four element groups covering:

- project management
- data generation/acquisition
- assessment and oversight, and
- data validation/usability

Each element group is further divided into elements covering different topics, for a total of twenty-four (24) elements. **Not all elements will pertain to every monitoring project**; in addition, the amount of detail for each element will depend on the type of project, the data obtained, the decisions made, and the consequences of potential errors. More in-depth information on each of the elements can be found in *Guidance for Quality Assurance Project Plans, EPA QA/G-5*, (EPA/240/R-02/009, December 2002).

Group A - Project Management Elements

The Project Management Elements address administrative functions, project goals and approaches, and should provide the following information:

A1. Title and Approval Sheet - This element identifies the project, key officials, and documents the approval of the project plan. It may contain the following information:

- Title
- Submitting Organization's name
- Consultant name, if applicable
- Location (City, State)
- Date
- Document number, if applicable
- Provisional Page for approval signatures of all parties involved

A2. Table of Contents Page - This element lists the different information sections of the plan.

A3. Distribution List - This element contains a listing of all individuals and organizations receiving a copy of the plan.

A4. Project Organization - A section that identifies the key individuals involved with the project and their respective roles and responsibilities. It should include the principal data

users, the decision makers, the project QA officer, and all those responsible for project implementation. It also should include other data users outside of the organization generating data (e.g., for whom the data is intended), and should identify any subcontractor relevant to environmental data operations, including laboratories providing analytical services. A concise organization chart should be included showing lines of authority and lines of reporting responsibility.

A5. Problem Definition/Background and Project Objective(s) – This section provides a narrative of the specific problem to be solved, decision to be made, or outcome to be achieved. There should be sufficient background information to provide a historical, scientific, and regulatory perspective. It should state the reason for the monitoring (e.g., Prevention of Significant Deterioration (PSD), SO_2 Rule (326 IAC 7-3), Agreed Order, Special Purpose Monitoring, or State Implementation Plan) and the applicable National Ambient Air Quality Standards (NAAQS). The current NAAQS values can be found on the USEPA website www.epa.gov/air/criteria.html. The Data Quality Objectives (DQOs) should be defined in this section. DQOs are qualitative and quantitative statements that clarify study objectives, define the appropriate type of data, and specify tolerable levels of potential decision errors that will be used as the basis for establishing the quality and quantity of data needed to support decisions. (Ref: *Guidance on Systematic Planning using the Data Quality Objective Process, EPA QA/G-4,* (EPA/240/B-06/001, February 2006).

A6. Project/Task Description – This section provides a management summary of all work to be performed, measurements to be taken, and the schedule for implementation of the project. It may include an introductory map showing the geographic locations of field tasks.

A7. Quality Objectives and Criteria for Measurement of Data – This section describes data quality indicators of the project (e.g., the Measurement Quality Objectives (MQOs) for each parameter to be collected). Measurement Quality Objectives are designed to evaluate and control various phases (sampling and analysis) of the measurement process to ensure that total measurement uncertainty is within the range prescribed by the data quality objectives. MQOs for each of the ambient air criteria pollutants can be found in EPA's *Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II: Ambient Air Quality Monitoring Program*, (EPA-454/B-08-003, December 2008). MQOs can be defined in terms of the following data quality indicators:

- Precision
- Accuracy
- Bias
- Representativeness
- Detectability
- Completeness
- Comparability

A8. Special Training/Certifications – This section describes any specialized training or certifications needed by personnel in order to complete the project or task. It should discuss how such training is to be provided and how the necessary skills are assured and documented.

A9. Documents and Records – This section itemizes all the documents and records that will be produced, such as final reports, audits, and Quality Assurance Project Plan revisions. It also lists field logs, sample preparation and analysis logs, laboratory analysis, instrument printouts, model inputs and outputs, data from other sources such as databases or literature, the results of calibration and QC checks. Copies of example data sheets should be included in an appendix of the plan.

Group B - Measurement and Data Acquisition Elements

The elements in this section address data generation, data acquisition, and data management activities.

B1. Sampling Process Design - This section is a description of the data collection design and needs to define the key parameters, the types and numbers of samples, the design assumptions, the mechanics of data collection (the where, when and how samples are to be taken), and the rationale for the design. It should include the following activities:

- Developing and understanding the monitoring objective(s) and appropriate data quality objectives. It should review the permit status and the length of time that is mandatory for monitoring (including the expected start date of the project). The description needs enough detail so that the reviewer can determine compliance with the conditions stated in the permit. The reviewer is encouraged to use the on-line Air Permits search to locate the reporting organization's operating permit for further information
- Identifying the appropriate NAAQS requirements for the project
- Identifying the spatial scale most appropriate for the site(s) monitoring objective
- Identifying the general site location(s) where monitoring site(s) should be placed. The monitoring network needs to be designed to meet the project's objectives. In most cases, a computer model and other pertinent information (e.g., historical meteorological conditions) were used to locate the high impact area in which the sites are to be located. The name of the model, the model input parameters, and the modeling results should be included
- Identification of specific monitoring sites. This section should provide general information regarding the site (address, AQS identification number) and how the site conforms to siting criteria. This section will include type of ground cover, topography of the site, land usage surrounding the site, and general meteorological conditions of the area. Photographs of the site, photographs of the cardinal and ordinal directions surrounding the site and topographic maps or aerial photographs, should be included, if possible. The site description also must include Universal Transverse Mercator

(UTM) coordinates, longitude and latitude coordinates, elevation of the site, and any other references useful in locating the air-monitoring site via geographical information systems (GIS)

B2. Sampling Methods – This section should describe the procedures for collecting the samples and identify the sampling methods (including the names, models and manufacturers of all equipment), equipment calibration and maintenance, and specific performance requirements. In addition, it should describe the support equipment (audit/calibration equipment, meteorological equipment) used to verify and validate the air data. To establish the basic validity of such air monitoring data, it must be shown that:

- The proposed sampling method complies with the appropriate testing regulations (e.g., the USEPA equivalency numbers for the analyzers used in the network)
- The equipment is accurately sited, including descriptions of shelters and environmental controls necessary to maintain shelter environment and information on the sampling train (e.g., material type, length and residence time of the sampling train, probe inlet height)
- The equipment is accurately calibrated using correct and established calibration methods (e.g., all calibration and auditing equipment necessary for the monitoring project must be listed)
- The organization implementing the data collection operation is qualified and competent. This section describes the methods for operating the equipment and the collection of data. It should include all standard operating procedures (SOPs) for the operation of the monitoring and meteorological equipment and site visit procedures by the station operator. Included in this section is information on corrective actions to be taken when problems occur and documentation of the problem and corrective actions undertaken

Some of this information may be provided in the appendices by specific reference to existing equipment, equipment specifications, methods, field/laboratory Standard Operating Procedures (SOPs), and Quality Assurance/Quality Control (QA/QC) Manuals.

B3. Sample Handling and Custody – This section describes the requirements for sample handling and custody. This section is important when the project plan requires filter based sampling.

- Sample handlings - The various phases of sample handling are sample labeling, sample collection and sample transportation
- Chain of Custody – If the results of a sampling program are to be used as evidence, a written record must be available tracking location and possession of the sample/data at all times

Sample handling forms, sample custody forms, and the associated SOPs can be included in the appendices

B4. Analytical Methods – This section identifies the analytical methods and equipment required for the analysis of ambient air samples. Generally, these are manual sample collection methods for lead and particulates with subsequent laboratory analyses (including filter-weighing analysis).

B5. Quality Control (QC) – QC is the overall system of technical activities that measures the attributes and performance of a process, equipment, or service against defined standards to verify that they meet the stated requirements defined in this plan. This section describes the quality control activities and the frequency of the activities that will be used to control the monitoring process to validate sample data. These activities include procedures for auditing the equipment during internally performed quality control checks (e.g., span, precision, and zero checks, flow checks) and the use of filter and field blanks for a particulate network.

In addition, this section must state the control limits, standards traceability, and describe the corrective action to be taken when control limits are exceeded. Data QC/QA requirements should be summarized in table format (e.g., Data Validation Tables) for each parameter to be measured. These validation tables define criteria for accepting or rejecting pollutant and meteorological data.

B6. Instrument/Equipment Testing, Inspection and Maintenance – This section discusses the procedures used to verify that all instruments and equipment are maintained in sound operating condition and are capable of operating at acceptable performance levels. Elements to include in Instrument/Equipment Testing, Inspection and Maintenance documents are the following:

- Equipment lists – by monitoring group or station
- Spare equipment/parts lists – by equipment, including suppliers
- Inspection/maintenance frequency – by equipment
- Equipment replacement schedules
- Sources of repair – by equipment
- Monthly check sheets and entry forms for documenting testing, inspection, and maintenance performed
- Standard operating procedures for equipment testing, inspections, and maintenance (this documentation can be included in the Appendices).

B7. Instrument/Equipment Calibration and Frequency – This section identifies all instruments and other sampling, measuring or test equipment used for data collection activities that must be calibrated to maintain performance within specified limits and be representative of the ambient environment to be measured. It identifies certified equipment and the procedures used for calibration. It identifies the standards (primary, secondary, etc.), their

traceability to known master standards, their certification and expiration dates. For standards where certification extends over a measurement range (e.g., thermometers, flow meters, etc.), this section also specifies the range over which these respective standards are traceable. This section also specifies how records of calibration are to be maintained. Documentation should be readily available for review and should include calibration data, calibration equations, analyzer identification, calibration date, analyzer location, shelter temperature at the time of the calibration, calibration standards used and their traceabilities, and the person conducting the calibration.

B8. Inspection/Acceptance of Supplies and Consumables –Describes how and by whom supplies and consumables (e.g., standard materials and solutions, filters, tubing, volumetric glassware, gas manifolds, sample bottles, water purity, calibration gases, reagents, electronic data storage media) are inspected and accepted for use in the project. The acceptance criteria should be stated.

B9. Non-direct Measurements – This section identifies the type of data needed for project implementation or decision-making that is obtained from non-measurement sources such as maps, charts, GPS latitude/longitude measurements, computer databases, programs, literature files and historical databases (e.g. climatology). It describes the acceptance criteria for the use of such data and specifies any limitations to the use of the data.

B10. Data Management – This section describes the project data management process, tracing the path of the data from generation to final use or storage. It discusses the control mechanism for detecting and correcting errors as well as performance audits of the data management system.

Group C - Assessments and Oversight Elements

This section of the report details what assessments or evaluations will occur during and after the project and is designed to assess whether the plan is being implemented as approved. It should include, as a minimum, the following information:

C1. Assessments and Response Actions – This section describes the evaluation processes and criteria used to measure the performance or effectiveness of the QA/QC system, the monitoring network, and various data quality indicators. These assessments include, but are not limited to:

- Management Systems Reviews
- Network Reviews
- Technical Systems Audits
- Performance Audits (Accuracy) by an independent external party
- Data Quality Audits
- Corrective Action Reports and Corrective Action Responses

This section will specify the frequency, acceptance criteria, and type of project

assessments to be undertaken. It describes how and to whom the results of the assessment are reported and discusses how response actions to assessment findings, including corrective actions for deficiencies and non-conforming conditions, are to be addressed and by whom. It discusses the process for revising an approved AMQAPP, if necessary.

C2. Reports to Management – This section describes the frequency, content, responsible individual, and distribution of assessment reports to management and other recipients. These reports include the following:

- QA Annual Report
- Network Reviews
- Quarterly Reports and the submission of Air Quality System (AQS) compatible parameter data and precision/accuracy reports. Data submission formats for AQS can be found on the USEPA website www.epa.gov/ttn/airs/airsaqs/
- Performance Audit Reports
- Corrective Action Reports and Corrective Action Responses
- NAAQS exceedance reporting to the IDEM Ambient Monitoring Branch, including the investigation into the cause of the high values and any corrective actions undertaken to prevent a recurrence

Group D. Data Validation and Usability Elements

The elements in this group address the final project check to determine if the data obtained will conform to the project's objectives, and to estimate the effect of any deviations.

D1. Data Review, Verification, & Validation Requirements – The purpose of this section is to state the criteria used to review and validate—that is, accept, reject or qualify—data in an objective and consistent manner. It is a way to decide the degree to which each data item has met its quality specifications as described in the Measurement and Data Acquisition Elements.

- Data verification is the process for evaluating the completeness, correctness, and conformance of a data set against method, procedural, or contractual specifications
- Data validation focuses on the quality of the data relative to the project's specifications and needs

D2. Validation and Verification Methods – This section describes the process for validating and verifying data. It discusses how issues are resolved and identifies the authorities for resolving such issues. It describes how the results are to be conveyed to the data users. Any project-specific calculations are identified in this section.

D3. Reconciliation with User Requirements – The purpose of this section is to outline and specify the acceptable methods for evaluating the results obtained from the project. It includes scientific and statistical evaluations to determine if the data are of the right type,

quantity, and quality to support the intended use.

Group E. Appendices

This portion of the plan should include illustrations necessary to clarify information in the plan, references used to document requirements, any forms used for audits and calibrations, and other documentation that provide additional details for the plan. Standard operating procedures may be found in section, if not included in the main document.